

Effects of Uncertainties in Components on the Survival of Complex Systems

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When considering complex systems (i.e. systems composed of multiple components) in practice, the failure behaviour of the components is usually not known precisely. This is particularly true in early development phases of a product. We study the influence of uncertainties in the marginal survival distributions of the components on one-dimensional properties of the system's survival distribution (e.g. expectation, quantiles). We do not assume that the components are independent; instead we require that their dependence is given by a known copula. We consider two approaches:

In the first approach we assume that the margins have a bounded distance from known distributions. This approach leads to bounds on the one-dimensional properties and requires the solution of a non-trivial optimization problem. We provide solutions for some special cases.

The second approach is Bayesian and assumes some prior distribution on the marginal distributions. For example one may assume that the margins belong to parametric classes and that distributions on the parameter spaces are given. In this approach we can compute or simulate the distribution of the one-dimensional property

An example of a mechanical system will be used to illustrate the above considerations.